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Quantum and stochastic branching programs of bounded width

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Abstract

We prove upper and lower bounds on the power of quantum and stochastic branching programs of bounded width. We show any NC1 language can be accepted exactly by a width-2 quantum branching program of polynomial length, in contrast to the classical case where width 5 is necessary unless NC1 = ACC. This separates width-2 quantum programs from width-2 doubly stochastic programs as we show the latter cannot compute the middle bit of multiplication. Finally, we show that bounded-width quantum and stochastic programs can be simulated by classical programs of larger but bounded width, and thus are in NC 1.© 2002 Springer-Verlag Berlin Heidelberg.